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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte KEVIN CAWLEY, WAYNE GOEKE, and
GREGORY SOBOLEWSKI

Appeal 2019-002244
Application 13/862,135
Technology Center 2800

Before LINDA M. GAUDETTE, JEFFREY B. ROBERTSON, and MICHAEL G. McMANUS, *Administrative Patent Judges.*

GAUDETTE, *Administrative Patent Judge.*

DECISION ON APPEAL[1]

The Appellant[2] appeals under 35 U.S.C. § 134(a) from the Examiner's decision finally rejecting claims 1, 3, 4, and 6–12.[3]

We reverse.

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[1] This Decision includes citations to the following documents: Specification filed Apr. 12, 2013 ("Spec."); Final Office Action dated Oct. 6, 2017 ("Final"); Appeal Brief filed Aug. 6, 2018 ("Appeal Br."); Examiner's Answer dated Nov. 16, 2018 ("Ans."); and Reply Brief filed Jan. 16, 2019 ("Reply Br.").

[2] We use the word "Appellant" to refer to the "applicant" as defined in 37 C.F.R. § 1.42(a). The Appellant identifies the real party in interest as Keithley Instruments, LLC. Appeal Br. 3.

[3] We have jurisdiction under 35 U.S.C. § 6(b).

CLAIMED SUBJECT MATTER

The invention relates "to a power supply that is designed to power a capacitive device under test (DUT), such as a battery-operated wireless device that requires high-bandwidth performance such as those that have current pulse loading and require extremely fast load regulation at the end of long cables." Spec. ¶ 17. The power supply simulates the battery to the DUT, e.g., a cellular phone, or provides an arbitrary voltage to the DUT. *Id.* ¶¶ 11, 17.

The power supply "is generally designed so that neither the transient response thereof nor its stability are affected by the cable or the load to which the cable is connected." *Id.* ¶ 21. The power supply is a high-bandwidth voltage-controlled-current-source (VCCS) for sending power over the load cables to the DUT. *Id.* "The stability and transient response may be set by the current sources gain, gm, and an external capacitor provided with the power supply and located close to the DUT, e.g., at the end of the cable." *Id.* The voltage-controlled-current-source has a specific, e.g., high transconductance (g_m). *Id.* ¶ 22. "The output impedance of the supply at direct current (DC) is generally equal to $1/g_m$, and the provided capacitor is typically a very good high-frequency capacitor of 10[μ]F in value, for example." *Id.* "The parasitics of the capacitor may be extremely small in order to dominate any parallel capacitance supplied by the DUT." *Id.*

Figure 4 illustrates an embodiment of the inventive system, and is reproduced below. *Id.* ¶ 15.

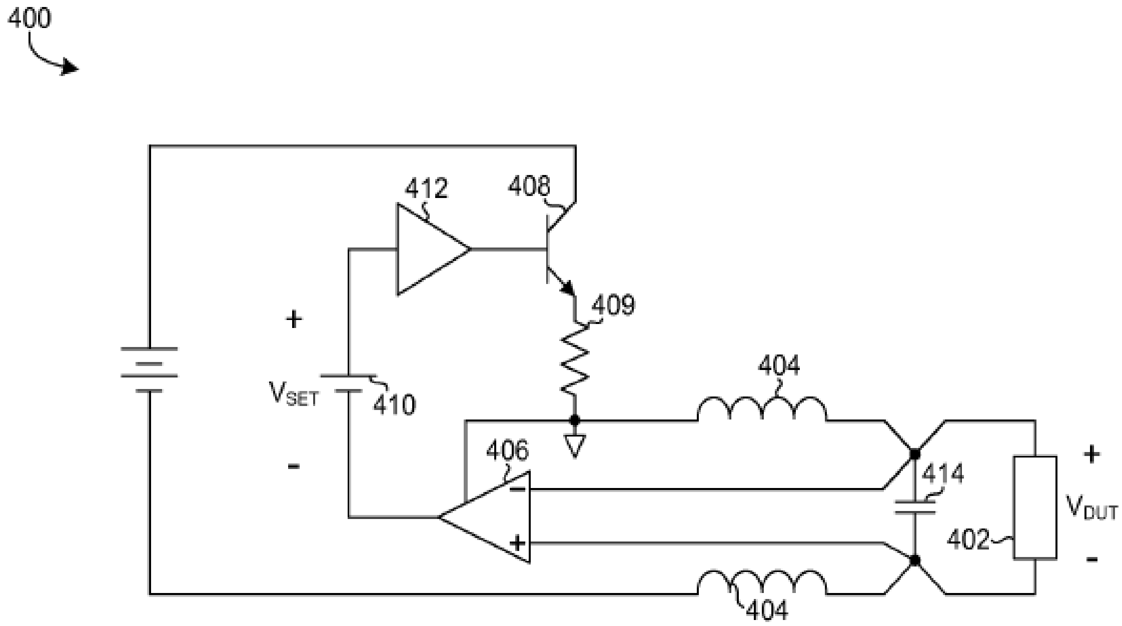


FIGURE 4

In Figure 4, a VCCS consists of NPN transistor 408 coupled with resistor 409, voltage source 410 (V_{SET}), amplifier 412, and op-amp 406. Spec. ¶ 33. DUT 402 has voltage V_{DUT} and impedance Z_{DUT}, and cable inductance 404 provides L_{CABLE}. *Id.* "[C]apacitor 414 . . . is positioned close to the DUT 402 and is large enough to dominate the loop depending on the implementation. For example, if the capacitance of a cellular phone is 5–10 μF, then the value of the capacitor 414 should be 10 μF." *Id.*

Claim 1, reproduced below, is illustrative of the claimed subject matter:

> 1. A system for sourcing a voltage for a device under test (DUT), comprising:
>
> a voltage-controlled-current source (VCCS);

> a first cable coupled with a positive terminal of the VCCS configured to be coupled with a positive terminal of the DUT via a first cable end;
>
> a second cable coupled with a negative terminal of the VCCS configured to be coupled with a negative terminal of the DUT via a second cable end;
>
> a capacitor coupling the first cable to the second cable at a point between the VCCS and the first and second cable ends, the capacitor being independent of a capacitance of the DUT, wherein the capacitor is configured to dominate an open loop gain frequency roll-off through a gain of one, and wherein the capacitor is included in a voltage feedback loop for the VCCS such that a change in voltage across the capacitor causes a change in current provided by the VCCS.

Appeal Br. 15 (Claims Appendix).

REJECTIONS

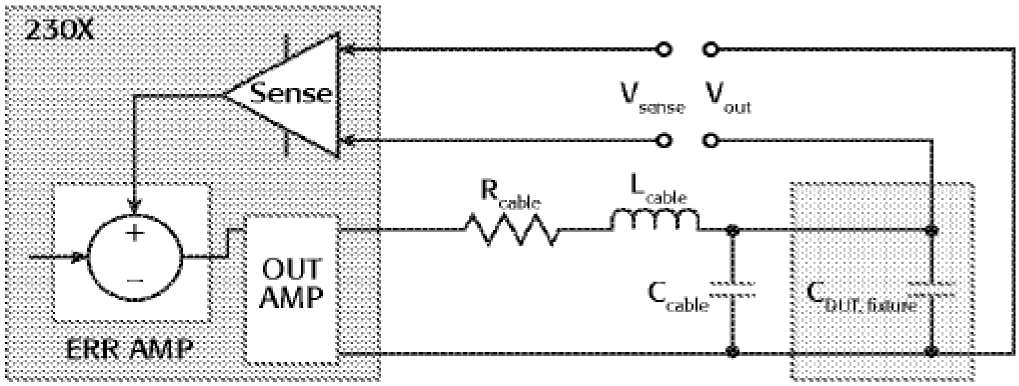
1. Claims 1, 3, and 6 are rejected under 35 U.S.C. § 103 as unpatentable over Keithley ("*Stabilizing Fast Transient Response Power Supply/Load Circuits*, Keithley Application Note Series 2870 (Dec. 31 2007)).

2. Claims 4 and 7–10 are rejected under 35 U.S.C. § 103 as unpatentable over Keithley in view of van Ettinger (US 2006/0273771 A1, pub. Dec. 7, 2006).

3. Claims 11 and 12 are rejected under 35 U.S.C. § 103 as unpatentable over Keithley in view of Hashimoto (US 2011/0018549 A1, pub. Jan 27, 2011).

OPINION

Keithley discloses "Series 2300 Battery/Charger Simulators (fast transient response power supplies) [that] are . . . designed for powering RFIC power amplifiers, mobile phone handsets, and other portable, battery-operated products in R&D and manufacturing environments.” Keithley[4] p. 1, col. 1. For reference, Keithley Figure 2 is reproduced below.



Keithley Figure 2 is a “Simplified Series 2300 measurement schematic with reactive load and remote-sense feedback.” *Id.* at col. 2.

The Examiner found that Keithley discloses a system for sourcing a voltage for a device under test (DUT) as recited in claim 1, with the exception of a “capacitor . . . configured to dominate an open loop gain frequency roll-off through a gain of one” (claim 1). *See* Final 2–3. The Examiner found that one of ordinary skill in the art would have configured Keithley’s capacitor to dominate an open loop gain frequency roll-off through a gain of one to obtain more stable regulation with a faster transient response. *Id.* at 3.

The Appellant argues that the Examiner erred reversibly in finding that Keithley’s power supply 230X is a VCCS. Appeal Br. 10. The Appellant argues that power supply 230X is a voltage-controlled-voltage-source (“VCVS”). *Id.* In support of this argument, the Appellant quotes

[4] Keithley does not include page numbers. For citation purposes, we have numbered the pages as 1–6.

Keithley page 1, column 2: "[t]he sense amplifier measures the voltage directly at the load to force the power supply output to increase its voltage to overcome the losses in the test leads and fixture to ensure the desired (or programmed) voltage is applied to the load." Appeal Br. 10–11. The Appellant also argues that Keithley teaches away from including "a capacitor 'configured to dominate an open loop gain frequency roll-off through a gain of one' as recited in claim 1." Appeal Br. 11; *see also id.* at 12 (citing Keithley p. 2, col. 1).

The Examiner determines that "[t]he term 'voltage-controlled-current source' means that through an input voltage, an output current source is controlled." Ans. 2. The Examiner contends that Keithley's power supply 230X inputs a voltage V_{sense} from the output voltage V_{out} and, based on input voltage V_{sense}, power supply 230X generates a current through the output stage (OUT AMP). *Id.* at 2–3. According to the Examiner, "[i]t is well known in the art that the last stage of an amplifier has a transistor in series with a resistor to control the output current." *Id.* The Examiner further notes that "in electrical circuits, the voltage and current are two values directly related one with another, and if the voltage changes this change is reflected in the current and vice versa." *Id.* (referencing "Kirchhoff's circuit law V=I*R"). Regarding the capacitor, the Examiner contends that the Appellant's argument is based on Keithley's description of the disadvantages of using a large capacitor in parallel with the DUT. *Id.* at 4. The Examiner argues that the rejection is based on Keithley's Figure 2 embodiment, whereas the Appellant's argument is based on Keithley's Figure 4 embodiment. *Id.* The Examiner argues that the Figure 2 embodiment uses capacitors to minimize AC noise and includes a bypass capacitor with a value of 10μF around the DUT, which is the same capacitance described in the Appellant's Specification. *Id.* (citing Spec. ¶ 33).

In response, the Appellant argues that Kirchhoff's circuit law "is a simple formula for purely resistive loads, but the relationship between voltage and current is more complex when dealing with reactive loads, such as the reactive load shown in Keithley Fig. 2." Reply Br. 2–3. The Appellant argues that Keithley's voltage source 230X suffers from oscillations when used with a high reactive load, and, therefore, Keithley is directed to "provid[ing] methods for stabilizing the load circuit." *Id.* at 3 (quoting Keithley p. 1, col. 1). According to the Appellant, "[a]s one of ordinary skill in the art would understand from Keithley, because the 230X is a voltage source and not a current source, these oscillations are caused by the impedance of the cable and the impedance of the DUT interacting to affect the feedback control loop of the voltage source 230X." *Id.* (citing Keithley p. 2, col. 1). As to the Examiner's contention that Keithley does not teach against using a capacitor with a value of 10μF, the Appellant cites Keithley page 3, column 1, as evidence that Keithley teaches "eliminating any capacitors in parallel with the DUT." *Id.* at 4.

The Appellant's arguments are persuasive of error in the Examiner's conclusion of obviousness. More specifically, the Appellant has persuaded us that the evidence fails to support the Examiner's findings that Keithley discloses or suggests a VCCS and a capacitor as claimed.

Keithley discloses that "[c]ertain high reactance load conditions, such as long wire runs and capacitive loads with low equivalent series resistance (ESR), can cause the power supply output to begin oscillating." Keithley p.

1, col. 1. Similarly, the background section of the Specification discloses that prior art attempts to solve the need for a fast transient response power supply that has stable voltage in response to fast edge, high current pulses from a DUT "generally include long inductive cables that cause a demand for high bandwidth of the power supply but also cause stability problems due to the inductance of the cables reacting with the capacitance of the DUT." Spec. ¶ 2. Keithley "describe[s] the various load circuit conditions that can cause oscillation and provide[s] methods for stabilizing the load circuit." Keithley p. 1, col. 1. More specifically, Keithley discloses the following four methods to ensure a stable load circuit:

> 1. Decreasing L_{cable}: Using good wiring techniques and low impedance cable
>
> 2. Decreasing C_{Total}: Eliminating unnecessary capacitors, typically on the test fixture
>
> 3. Increasing R_{Cable}: Adding resistance to the load circuit
>
> 4. Adding a compensation network to the load circuit.

Id. at p. 2, col. 1. Keithley discloses that a "way to lower cable inductance is to keep the cable as short as possible. . . . [R]outing the cabling as directly as possible to keep the cable length as short as possible helps ensure system stability." *Id.* at p. 3, col. 1. Keithley further discloses that "[w]herever possible, eliminate any capacitors in parallel with the DUT. . . . Eliminating capacitors reduces the total capacitance in the load circuit, so removing a parallel capacitor at the DUT will improve the load circuit's performance." *Id.* By contrast, the Specification discloses that

> [a] power supply in accordance with the disclosed technology is generally designed so that neither the transient response thereof nor its stability [is] affected by the cable or the load to which the cable is connected. Such a power supply

> generally consists of a high-bandwidth voltage-controlled-current-source for sending power over the load cables to the DUT. The stability and transient response may be set by the current sources gain, gm, and an external capacitor provided with the power supply and located close to the DUT, e.g., at the end of the cable.

Spec. ¶ 21.

In sum, for the reasons discussed in the Appeal and Reply Briefs, we are persuaded that the Examiner's conclusion of obviousness as to claim 1 is not supported by a preponderance of the evidence. Because the remaining claims depend from claim 1, and the Examiner has not identified teachings in van Ettinger or Hashimoto that cure the above noted deficiencies in Keithley, we reverse all three grounds of rejection.

CONCLUSION

Claims Rejected	**35 U.S.C. §**	**Reference(s)/Basis**	**Affirmed**	**Reversed**
1, 3, 6	103	Keithley		1, 3, 6
4, 7–10	103	Keithley, van Ettinger		4, 7–10
11, 12	103	Keithley, Hashimoto		11, 12
Overall Outcome				1, 3, 4, 6–12

REVERSED